

1        1.    A method of forming a micromechanical actuator for a storage device, the method  
2 comprising:

3                providing a read/write slider;

4                forming a movable member coupled with the read/write slider; and

5                forming an electro-thermal actuator element in contact with the movable  
6 member to effect relative positioning of the read/write slider.

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8                2.        The method of claim 1, wherein forming the movable member further  
9 comprises lithographically defining the movable member on the read/write slider.

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11               3.        The method of claim 2, wherein forming the movable member further  
12 comprises deep reactive ion etching the lithographically defined movable member.

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14               4.        The method of claim 1, wherein forming the movable member comprises  
15 forming a movable member having a proximal and a distal end, the proximal end attached  
16 to the slider and the distal end free-standing with respect to the slider.

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18               5.        The method of claim 4, wherein forming the movable member further  
19 comprises deep reactive ion etching a curved line a selected distance into a face of the  
20 read/write slider so as to form a free-standing movable member on the read/write slider that  
21 is coupled to the read/write slider only at one end of the movable member.

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23               6.        The method of claim 5, further comprising etching a hole into the read/write  
24 slider perpendicular to the etching of the curved line to define a neck in the movable  
25 member.

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7. The method of claim 1, wherein forming an electro-thermal micromechanical actuator element on the movable member further comprises placing an electrically actuated heater element on the slider.

8. The method of claim 7, wherein placing an electrically actuated heater element on the slider further comprises sputtering a high melting point material with a melting temperature greater than about 500 degrees C on the surface of the slider opposite the air bearing surface of the slider.

9. The method of claim 7, wherein forming an electro-thermal micromechanical actuator element further comprises forming two electrical leads upon the movable member, the two electrical leads comprising a first lead and second lead, the first lead substantially narrower than the second lead.

1           10.    A method of forming a micromechanical actuator for a storage device,  
2 comprising:

3               forming a read/write slider;

4               lithographically defining a movable member on a body of the read/write  
5 slider;

6               reactive ion etching the lithographically defined movable member to form the  
7 movable member with a proximal and a distal end, the proximal end attached to the  
8 slider and the distal end free-standing with respect to the slider; and

9               forming an electrically actuated heater element on the surface of the  
10 read/write slider opposite the air bearing surface of the slider by forming first and  
11 second substantially coextensive leads, the first lead substantially narrower than the  
12 second lead, such that the first lead heats up more quickly than the second lead when  
13 current is applied to the heater element causing a displacement of the movable  
14 member and relative positioning of the read/write slider.

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16           11.    A micromechanical actuator for a storage device, comprising:

17               a read/write slider;

18               a movable member coupled with the read/write slider; and

19               an electro-thermal actuator element in contact with the movable member, to  
20 effect relative positioning of the read/write slider.

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22           12.    The micromechanical actuator of claim 11, wherein the read/write slider  
23 comprises a reactive ion etchable material.

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25           13.    The micromechanical actuator of claim 11, wherein the movable member  
26 comprises a freestanding structure attached at one end to the read/write slider.

1           14.       The micromechanical actuator of claim 11, wherein the movable member  
2 further comprises a proximal end and a distal end, the proximal end attached to the slider  
3 body and the distal end free-standing with respect to the slider body.

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5           15.       The micromechanical actuator of claim 14, wherein the movable member  
6 further comprises a tongue-shaped region etched out of a face of a body of the read/write  
7 slider.

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9           16.       The micromechanical actuator of claim 14, wherein the movable member  
10 further comprises an integral, elongated portion of the slider body defined at the distal end  
11 by a leading edge of the slider body, defined at a top end by the top of the slide body, defined  
12 at a bottom by a trench having the shape of a curved plane extending laterally through the  
13 slider body and extending from a first side member to a second side, the movable member  
14 attached at the proximal end to the slider body.

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16           17.       The micromechanical actuator of claim 16, further comprising a hole disposed  
17 substantially at the proximal end of the movable member, the hole defining a narrow neck  
18 in the rear of the movable member.

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20           18.       The micromechanical actuator of claim 11, wherein the electro-thermal  
21 actuator element further comprises an electro-thermal heater element placed substantially on  
22 the movable member.

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24           19.       The micromechanical actuator of claim 18, wherein the electro-thermal heater  
25 element comprises first and second leads extending in two substantially parallel directions  
26 on the movable member, the first lead extending along a first side of the movable member  
27 and the second lead extending along a second side of the movable member, the first lead

1           14.       The micromechanical actuator of claim 11, wherein the movable member  
2 further comprises a proximal end and a distal end, the proximal end attached to the slider  
3 body and the distal end free-standing with respect to the slider body.

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5           15.       The micromechanical actuator of claim 14, wherein the movable member  
6 further comprises a tongue-shaped region etched out of a face of a body of the read/write  
7 slider.

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9           16.       The micromechanical actuator of claim 14, wherein the movable member  
10 further comprises an integral, elongated portion of the slider body defined at the distal end  
11 by a leading edge of the slider body, defined at a top end by the top of the slide body, defined  
12 at a bottom by a trench having the shape of a curved plane extending laterally through the  
13 slider body and extending from a first side member to a second side, the movable member  
14 attached at the proximal end to the slider body.

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16           17.       The micromechanical actuator of claim 16, further comprising a hole disposed  
17 substantially at the proximal end of the movable member, the hole defining a narrow neck  
18 in the rear of the movable member.

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20           18.       The micromechanical actuator of claim 11, wherein the electro-thermal  
21 actuator element further comprises an electro-thermal heater element placed substantially on  
22 the movable member.

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24           19.       The micromechanical actuator of claim 18, wherein the electro-thermal heater  
25 element comprises first and second leads extending in two substantially parallel directions  
26 on the movable member, the first lead extending along a first side of the movable member  
27 and the second lead extending along a second side of the movable member, the first lead

1 being substantially narrower than the second lead such that passing a current through the  
2 electro-thermal heater element distorts the movable member to one side or the other in a  
3 selected manner depending upon the amount of current that is passed through the electro-  
4 thermal heater element.

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6 20. A method of operation of a positioning system of a storage device,  
7 comprising:

8 detecting the position of a read/write slider with relation to the centerline of  
9 a read/write track of a storage device;

10 determining the magnitude and direction of motion necessary to place a  
11 read/write slider over the centerline of the read/write track of a storage device; and

12 supplying a current to an electro-thermal micromechanical actuator located  
13 on the read/write slider to cause the electro-thermal micromechanical actuator to  
14 position the read/write slider over the centerline of the read/write track of the storage  
15 device.

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17 21. The method of claim 20, wherein supplying a current to an electro-thermal  
18 actuator such that the actuator positions the read/write slider over the centerline of the  
19 read/write track of the storage device further comprises channeling the current through an  
20 electrically actuated heater element located upon the read/write slider.

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22 22. The method of claim 21, wherein channeling the current through an  
23 electrically actuated heater element located upon the read/write slider causes a movable  
24 member located upon the read/write slider to distort as the electrically actuated heater  
25 element changes temperature when current is passed through it.

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23. The method of claim 22, wherein the distortion caused in the movable member by the change in temperature of the heater element creates a finite motion of the read/write slider.

24. The method of claim 20, further comprising gross positioning of the read/write slider prior to the supplying of a current to an electro-thermal micromechanical actuator located on the read/write slider.

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